

TRANSMITTAL OF APPEAL BRIEF (Large Entity)

Docket No.
POU920000112US1

In Re Application Of: Sawdon et al.

Serial No.
09/618,508

Filing Date
07/18/2000

Examiner
Alam, S.

Group Art Unit
2172

Invention: PLURALITY OF FILE SYSTEMS USING WEIGHTED ALLOCATION
TO ALLOCATE SPACE ON ONE OR MORE STORAGE DEVICES

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Dated: February 17, 2004

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Appellants: Sawdon et al. : Group Art Unit: 2172
Serial No.: 09/618,508 : Examiner: Shahid Al Alam
Filed: 07/18/2000 : Appeal No.:
Title: PLURALITY OF FILE SYSTEMS USING WEIGHTED ALLOCATION TO
ALLOCATE SPACE ON ONE OR MORE STORAGE DEVICES

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Brief of Appellants

Dear Sir:

This is an appeal from a final rejection, dated August 12, 2003, rejecting claims 1-12, 17-35, 40-60, and 65-71, and objecting to claims 13-16, 36-39, and 61-64 of the above-identified application. The Brief is due within two months from the date the Notice of Appeal was received at the United States Patent and Trademark Office. Since Appellants' postcard indicates that the Notice of Appeal was received on December 15, 2003, this Brief is due on or before February 15, 2004. However, February 15, 2004 is a Sunday and February 16, 2004 is a holiday, thus this Brief is being timely filed on February 17, 2004. This Brief is accompanied by a transmittal

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letter authorizing the charging of appellants' deposit account for payment of the requisite fee set forth in 37 C.F.R. §1.17(c).

Real Party in Interest

This application is assigned to **International Business Machines Corporation** by virtue of an assignment executed by the co-inventors on October 19, 2000, and recorded with the United States Patent and Trademark Office at reel 011335, frame 0040, on November 27, 2000. Therefore, the real party in interest is **International Business Machines Corporation**.

Related Appeals and Interferences

To the knowledge of the appellants, appellants' undersigned legal representative, and the assignee, there are no other appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in the instant appeal.

Status of Claims

This patent application was filed on July 18, 2000 with the United States Patent and Trademark Office. As filed, the application included seventy-one (71) claims, of which seven (7) were independent claims (i.e., claims 1, 23, 24, 46, 47, 49 and 71).

In an initial Office Action dated February 27, 2003, claims 1-12, 17-35, 40-60, and 65-71 were rejected under 35 U.S.C. 103(a) as being unpatentable over Grimsrud et al. (U.S. Patent No. 6,253,296, hereinafter, Grimsrud) in view of Smith (U.S. Patent 5,394,531, hereinafter, Smith); and claims 13-16, 36-39, and 61-64 were objected to as being dependent upon a rejected base claim, but indicated as allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Appellants timely filed a response to the initial Office Action in which no claims were amended on May 27, 2003.

In a second and final Office Action dated August 12, 2003, claims 1-12, 17-35, 40-60, and 65-71 were rejected under 35 U.S.C. 103(a) as being unpatentable over Grimsrud et al. (U.S.

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Patent No. 6,253,296) in view of Smith (U.S. Patent 5,394,531); and claims 13-16, 36-39, and 61-64 were objected to as being dependent upon a rejected base claim, but indicated as allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Appellants timely filed a response to the second and final Office Action in which no claims were amended on October 31, 2003. An Advisory Action dated November 17, 2003 indicated that appellants' response to the second and final Office Action did not place the application in condition for allowance.

A Notice of Appeal to the Board of Patent Appeals and Interferences was filed on December 12, 2003, accompanied by a Petition for Extension of Time to File Notice of Appeal in which a one-month extension of time was requested. The Notice of Appeal and Petition for Extension of Time were received at the United States Patent and Trademark Office on December 15, 2003. The status of the claims is therefore as follows:

Claims allowed – none;

Claims objected to – 13-16, 36-39, and 61-64;

Claims rejected – 1-12, 17-35, 40-60, and 65-71; and

Claims canceled – none.

Appellants are appealing the rejection of claims 1-12, 17-35, 40-60, and 65-71.

Status of Amendments

No claim amendment was effectuated by the Response to Final Office Action dated October 31, 2003. Further, because no prior amendments of the claims have been entered, the claims as set out in Appendix A are as originally filed.

Summary of Invention

In one aspect, the present invention is directed to the problem of multiple file systems allocating space on one or more storage devices in a computing environment.

More particularly, in one aspect, the present invention is a method (claims 1 and 23), system (claims 24, 46, and 47), and program storage device, embodying a program of instructions readable and executable by a machine to perform the method (claims 49 and 71), for managing the allocation of space on storage devices of a computing environment (page 9, lines 1-4; see page 9, lines 16-23). The method includes obtaining one or more weights (page 9, lines 5-6; page 10, lines 15-20; page 15, line 20 through page 18, line 11) for one or more storage devices 104 of the computing environment 100 (FIG. 1; page 9, lines 16-23), and allocating space on at least one of one or more storage devices in proportion to at least one weight obtained for the storage devices, wherein the allocating is performed by a plurality of file systems of the computing environment (see page 9, lines 9-13; page 10 line 15-18; and page 13, lines 21-24).

In another aspect of the present invention, one or more weights for the storage devices are adjusted or maintained in response to a file system failure (claims 18 and 20). (FIGs. 7, 8, 9, and 10; page 23, line 1 to page 29, line 17.)

In other aspects of the present invention, each file system executes an allocation technique and at least one file system is executing a different allocation technique than at least one other file system (claim 4) (page 18, lines 21-26); and each of a plurality of file systems allocates space on one or more of a plurality of storage devices (claim 6) (page 11, lines 20-27).

In a further aspect (see claim 2) of the method in accordance with an aspect of the invention, each of the plurality of file systems is located on a separate node of the computing environment (page 9, lines 16-21; FIG. 1, 100 and 102; and page 10, lines 8-11). Yet another aspect of the method of the present invention is informing a plurality of file systems of changes in one or more weights for the storage devices (claim 17) (page 18, lines 12-15; page 21, lines 5-8; and FIG. 6, 606).

Issues

1. Whether claims 1-12, 17-35, 40-60, and 65-71 were rendered obvious under 35 U.S.C. 103(a) as being unpatentable over Grimsrud in view of Smith.

Grouping of Claims

There is one ground of rejection, and thus, one group of claims, Group I. Group I includes claims 1-12, 17-35, 40-60, and 65-71; however, the claims of Group I do not stand or fall together. Instead, each of the following subgroups of Group I includes claims that provide a separate basis of patentability.

- (i) Claims 1, 3, 5, 7-12, 21-24, 26, 28, 30-35, 44-48, 49, 51, 53, 55-60 & 69-71;
- (ii) Claims 6, 29 & 54;
- (iii) Claims 2, 25 & 50;
- (iv) Claims 18-20, 41-43 & 66-68;
- (v) Claims 4, 27, & 52; and
- (vi) Claims 17, 40 & 65.

As understood, the claims of one subgroup of claims do not stand or fall with any other subgroup of claims, except that, if the claims of subgroup (i) stand, then the claims of subgroups (ii)-(vi) stand because they depend from the independent claims of subgroup (i). However appellants respectfully submit that that none of the subgroups fall together because the claims of each subgroup provide a separate basis of patentability.

Argument

Claims 1-12, 17-35, 40-60, and 65-71, i.e. the claims of Subgroups (i), (ii), (iii), (iv), (v) and (vi) of Group I, stand rejected under 35 U.S.C. 103(a) as being unpatentable over Grimsrud in view of Smith.

Group I, Subgroup (i): Claims 1, 3, 5, 7-12, 21-24, 26, 28, 30-35, 44-48, 49, 51, 53, 55-60 & 69-71

As noted, claims 1, 3, 5, 7-12, 21-24, 26, 28, 30-35, 44-48, 49, 51, 53, 55-60 and 69-71 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Grimsrud in view of Smith.

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Appellants respectfully submit that the rejection of this subgroup is erroneous for the reasons below, and, therefore, respectfully request reversal of this rejection.

In one aspect, appellants' invention is directed to the allocation of space by a plurality of file systems across one or more storage devices, such that the space on a device is allocated, and thus, consumed in proportion to some weight assigned to that device. For example, in independent claim 1, appellants claim a method of managing the allocation of space on storage devices of a computing environment. The method includes, for instance, obtaining one or more weights for one or more storage devices of the computing environment; and allocating space on at least one storage device of the one or more storage devices in proportion to at least one weight obtained for the at least one storage device, wherein the allocating is performed by a plurality of file systems of the computing environment. Thus, in appellants' claimed invention, space is allocated by a plurality of file systems. Further, space is allocated on at least one storage device in proportion to at least one weight associated with the at least one device. These aspects are very different from the teachings of Grimsrud and Smith, either alone or in combination.

The cited references do not teach or suggest, either alone or in combination, all of the elements of appellants' claimed invention. For instance, neither Grimsrud nor Smith teaches or suggests appellants' claimed element of "allocating space on at least one storage device..., wherein the allocating is performed by a plurality of file systems of the computing environment." This is explained in further detail below. Although appellants are aware that for an obviousness rejection, the references cannot be attacked individually, appellants, for clarity purposes, address each reference individually indicating how each of the references does not show a particular element. Since each reference fails to show that element, then combined those references also fail to teach or suggest that particular element.

As one example, Grimsrud fails to teach or suggest a plurality of file systems. Further, Grimsrud fails to teach or suggest allocating space on at least one storage device by a plurality of file systems. The only mention of a file system in Grimsrud is of a single file system (Col. 10, lines 44-45) or of a single file subsystem (Col. 9, line 23). There is no teaching or suggestion of

performing allocation by a plurality of file systems, as claimed by appellants. Thus, Grimsrud does not teach or suggest appellants' claimed invention.

In the Office Action, support for the rejection of this claim element is indicated at Col. 11, lines 43-57 and line 66 to Col. 12, line 3 of Grimsrud. Appellants respectfully submit that a careful reading of those sections do not teach a plurality of file systems. Those sections use the word plurality, but to refer to items other than a plurality of file systems. As examples, in Grimsrud, there is a mention of a plurality of program instructions, a plurality of model pruning criteria, and a plurality of file cluster units, but not of a plurality of file systems. There is no description of a plurality of file systems in Grimsrud, as claimed by appellants.

As described in the specification (e.g., page 2) and known in the art (e.g., see www.webopedia.com/term/f/file_management_system.html), a file system is used to manage operations relating to files. Appellants' invention is directed, in one aspect, to using a plurality of file systems to perform allocation on one or more storage devices. Grimsrud fails to describe or mention a plurality of file systems. Grimsrud is not concerned with the problems that arise when there are a plurality of file systems performing allocation, as evidenced by the absence of any mention of a plurality of file systems. Since Grimsrud is not concerned with allocation by a plurality of file systems, Grimsrud is directed to a different problem than that solved by appellants' invention. Again, in one aspect, appellants' invention is directed to managing allocation when there are a plurality of file systems performing that allocation. Methodologies that can be used for a single file system are typically not available when a plurality of file systems are involved. Appellants address the allocation by a plurality of file systems, unlike Grimsrud.

Further, just to clarify, a file cluster, which is a term used in Grimsrud, is distinct from a file system. Again, a file system is used to manage, while a file cluster is a particular unit of allocation (see, e.g., Col. 9, lines 23-25; and claim 3, lines 65-67). Thus, a plurality of file clusters is very different from a plurality of file systems.

Based on the foregoing, appellants respectfully submit that Grimsrud does not teach or suggest a plurality of file systems. Therefore, it follows that Grimsrud fails to teach or suggest allocating being performed by a plurality of file systems, as claimed by appellants.

Smith also fails to teach or suggest a plurality of file systems or performing allocation by a plurality of file systems, as claimed by appellants. Smith addresses allocating cache sizes and reallocating cache space (Abstract), but fails to even mention a file system, much less address problems associated with performing allocation by a plurality of file systems. Therefore, it also follows that Smith fails to teach or suggest allocating space on at least one storage device..., wherein the allocating is performed by a plurality of file systems.

Since both Grimsrud and Smith fail to teach or suggest appellants' claimed element of allocating space on at least one storage device of the one or more storage devices in proportion to at least one weight obtained for the at least one storage device, wherein the allocating is performed by a plurality of file systems, appellants respectfully submit that the combination also fails to teach or suggest this claimed element. Therefore, appellants respectfully request reversal of the rejection of independent claim 1, as well as the other independent claims, and all claims that depend therefrom.

As another example, neither Grimsrud nor Smith, either alone or in combination, teaches or suggests appellants' claimed element of allocating space on at least one storage device of said one or more storage devices in proportion to at least one weight obtained for the at least one storage device. Again, although appellants are aware that for an obviousness rejection, the references cannot be attacked individually, to provide the remarks in an organized fashion, each reference is discussed individually. However, again since each reference fails to teach or suggest a particular element, the combination of those references also fails to teach or suggest that element, as discussed below.

For example, Grimsrud fails to teach or suggest at least one weight obtained for at least one storage device. While weights are mentioned in Grimsrud, as indicated by the Examiner, those weights are associated with transition arcs used to represent the probability of a transition

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being made. The weights in Grimsrud are based on an application's reference pattern captured by a trace utility. The weights in Grimsrud are not associated with storage devices, as claimed by appellants. This is explicitly stated in Col. 9, lines 27-32 of Grimsrud, in which it is stated:

A weight is assigned to each transition arc to represent the probability of the transition being made. The weight (probability) is computed based on the number of occurrences of the transition observed, relative to other transitions from the node.

So, while weights are mentioned in Grimsrud, those weights are not the weights claimed by appellants. In particular, appellants claim at least one weight for at least one storage device. There is no mention in Grimsrud of weights for one or more storage devices. The mere mention of the word "weights" without it being weights for one or more storage devices, as claimed by appellants, does not and cannot teach or suggest appellants' claimed element. Thus, since there is no description at all in Grimsrud of a weight for a storage device, Grimsrud does not teach or suggest appellants' claimed invention.

Further, since there is no teaching or suggestion in Grimsrud of weights for one or more storage devices, it follows that Grimsrud also fails to teach or suggest allocating space on the storage device in proportion to at least one weight obtained for that storage device. This is missing from Grimsrud.

Similarly, Smith also fails to teach or suggest appellants' claimed element of allocating space on at least one storage device in proportion to at least one weight obtained for the at least one storage device.

In Smith, a weighting factor, assigned to each priority class of data (Col. 3, lines 37-43), is used to allocate space in a cache for each priority class. Smith depends on an application's references to adjust the weighting factor. In Smith, the weighting factor is used to determine the size of the partitions created in a cache for each priority class of data (see, e.g., Col. 6, lines 7-50). That is, Smith allocates space for a partition. It reserves space for a partition that is to be used as a resource for storing data (from a priority class) to service future write operations.

In contrast, appellants allocate space on a storage device, instead of reserving space for partitions of a storage device. Appellants do not determine the size of partitions or change the size of partitions which are reserved as resources for future write operations, but instead, find a location on a device for the data to be currently written (i.e., allocate space on a storage device). The allocating is in proportion to at least one weight obtained for the storage device. There is no teaching or suggestion in Smith of allocating space on a storage device in proportion to a weight obtained for that device, but instead, Smith teaches using a weighting factor to determine the size of partitions of a cache. Thus, appellants respectfully submit that Smith does not teach or suggest appellants' claimed invention.

Since both Grimsrud and Smith fail to teach or suggest appellants' claimed element of allocating space on at least one storage device in proportion to at least one weight obtained for the storage device, it follows that the combination of Smith and Grimsrud also fails to teach or suggest this claim element. Since this element is missing from both of the references, appellants respectfully request reversal of the rejection of independent claim 1, as well as the other independent claims, and all claims that depend therefrom.

To summarize, appellants respectfully submit that the combination of Grimsrud and Smith fails to teach or suggest at the very least appellants' claimed element of allocating space on at least one storage device of said one or more storage devices in proportion to at least one weight obtained for the at least one storage device, wherein said allocating is performed by a plurality of file systems of said computing environment. Neither Grimsrud nor Smith performs allocation by a plurality of file systems; Smith does not even mention a file system, and Grimsrud does not mention a plurality of file systems nor allocation by a plurality of file systems. Neither Grimsrud nor Smith allocates space on a storage device in proportion to a weight obtained for the storage device; Grimsrud does not describe a weight for a storage device, and Smith does not describe allocation on a storage device, but instead, sizing the partitions of a cache. Neither Grimsrud nor Smith allocates space on a storage device in proportion to a weight for the storage device, wherein the allocating is performed by a plurality of file systems. The combination of

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Grimsrud and Smith fails to teach or suggest one or more aspects of appellants' claimed invention.

For all the above reasons discussed, appellants respectfully request reversal of the rejection of the claims of Subgroup (i) of Group I. In addition, appellants respectfully request reversal of the rejection of claims 2, 4, 6, 17-20, 25, 27, 29, 40-43, 50, 52, 54, and 65-68, because the claims of Subgroups (ii), (iii), (iv), (v), and (vi) depend from the independent claims of Subgroup (i) of Group I.

Group I, Subgroup (ii): Claims 6, 29 & 54

Appellants respectfully submit that claims 6, 29, and 54 have a separate basis of patentability from the claims of the other subgroups, and that the rejection of the claims of this subgroup is erroneous for the reasons discussed below.

For example, claim 6 recites "said allocating comprises allocating space on a plurality of storage devices by a plurality of file systems." Thus, appellants explicitly recite a plurality of storage devices and a plurality of file systems. This is not taught or suggested by Grimsrud or Smith, either alone or in combination.

Grimsrud (Col. 1, lines 58-65) is cited in the final Office Action in rejecting claim 6. Appellants respectfully submit that a close reading of the cited portion of Grimsrud does not teach or suggest this claimed aspect of the present invention, but, rather, teaches a disk block reallocator that employs a model to improve disk block allocation. There is no teaching or suggestion of allocating space on a plurality of storage devices by a plurality of file systems.

Smith also fails to overcome the deficiencies of Grimsrud. Smith addresses an allocation problem in a single cache. There is no discussion of a plurality of storage devices or of a plurality of file systems.

Since neither reference teaches or suggests allocating space on a plurality of storage devices by a plurality of file systems, the combination of these references also fails to teach or

suggest this claimed element. Thus, appellants respectfully submit that claim 6 is patentable over the combination of Grimsrud and Smith.

The arguments presented above for claim 6 apply to the analogous system and program storage device claims 29 and 54, respectively. Therefore, appellants respectfully submit that the claims of Subgroup (ii) of Group I would not have been obvious to one with ordinary skill in the art because the applied art does not teach or suggest all aspects of the claimed invention either alone or in combination. Accordingly, appellants respectfully request reversal of the rejection of the claims of Subgroup (ii) of Group I.

Group I, Subgroup (iii): Claims 2, 25, & 50

Appellants respectfully submit that the claims of this subgroup have a separate basis of patentability from the claims of the other subgroups, and that the rejection of the claims of this subgroup is erroneous for the reasons herein.

For example, in dependent claim 2, appellants explicitly claim that each of the plurality of file systems is located on a separate node of the computing environment. In addition to not having a plurality of file systems as described above in regard to the claims of Subgroup (i), neither Grimsrud nor Smith teaches or suggests a plurality of nodes, as claimed by appellants.

While Grimsrud uses the term “node”, the use of that term in Grimsrud is very different from the use of that term by appellants. In Grimsrud, the node is a node in a model that represents an accessed file cluster (Col. 9, lines 23-25). In contrast, in appellants’ claimed invention, a node is a computing entity, such as a processor (see e.g., FIGs. 1 and 2), used in processing. There is no teaching or suggestion in Grimsrud of a plurality of file systems located on a plurality of nodes, as claimed by appellants. Further, Smith does not overcome the deficiencies of Grimsrud. In Smith, there is only one cache on one processor. There is no teaching or suggestion of a plurality of nodes or of a plurality of file systems located on a plurality of nodes, as claimed by appellants.

Since both Grimsrud and Smith fail to teach or suggest appellants' claimed element of "each of said plurality of file systems is located on a separate node of said computing environment", appellants respectfully submit that claim 2 and analogous dependent system and program storage device claims 25 and 50, respectively, are patentable over the combination of Grimsrud and Smith.

For the reasons stated above, appellants respectfully submit that claims of Subgroup (iii) of Group I would not have been obvious to one with ordinary skill in the art, and, therefore, appellants respectfully request reversal of the rejection of the claims of Subgroup (iii) of Group I.

Group I, Subgroup (iv): Claims 18-20, 41-43 & 66-68

Appellants respectfully submit that claims 18-20, 41-43, and 66-68 have a separate basis of patentability from the claims of the other subgroups, and that the rejection of the claims of this subgroup is erroneous for the reasons discussed below.

The dependent claims of Subgroup (iv) of Group I further recite either "adjusting", e.g. claim 18, or "maintaining", e.g. claim 20, "at least one weight of said one or more weights in response to a failure of a file system of said computing environment." The primary reference, Grimsrud, was cited (col. 9, lines 24-52) in the final Office Action as teaching maintaining at least one weight in response to a failure of a file system of a computing environment. However, appellants respectfully submit that Grimsrud does not even address a file system failure. Instead, the cited portion of Grimsrud teaches storing the weights of a model in a data structure. Thus, Grimsrud fails to teach or suggest this aspect of appellants' claimed invention.

Moreover, appellants respectfully submit that the secondary reference, Smith, does not cure this deficiency. Smith (col. 8, lines 1-25) was cited in the final Office Action as teaching adjusting at least one weight for a storage device in response to a failure of a file system. However, appellants respectfully submit that the cited portion of Smith teaches a method for adjusting the size of partitions in a cache assigned to prioritized classes of data based on the difference between measured and target hit ratios for the prioritized classes of data. There is no

teaching in Smith of adjusting weights, and no teaching of adjusting weights based on a failure of the file system. In Smith, it is the size of a partition that is being adjusted and not a weight. Further, the adjustment is based on the difference between measured and target hit ratios (a “hit” is recorded when data referenced by a process is found in the cache memory (Col. 1, lines 61-68)) and not based on file system failure. Therefore, there is no teaching or suggestion in Smith to adjust or maintain weights assigned to storage devices in response to a file system failure. Indeed, as discussed above with respect to the claims of Subgroup (i) of Group I, Smith does not even mention a file system. Because neither Grimsrud nor Smith teaches or suggests adjusting or maintaining weights assigned to storage devices in response to a file system failure, the combination of Grimsrud and Smith also fails to teach or suggest the claimed invention.

Also, appellants respectfully submit that claim 19 is patentable because it depends from claim 18. Since claims 41-43 and 66-68 are system and program storage device claims, respectively, that are analogous to claims 18-20, appellants respectfully submit that these claims are also patentable for the reasons discussed above with respect to claims 18-20.

For the reasons stated above, appellants respectfully submit that the claims of Subgroup (iv) of Group I would not have been obvious to one with ordinary skill in the art, and appellants respectfully request reversal of the rejection of the claims of Subgroup (iv) of Group I.

Group I, Subgroup (v): Claims 4, 27, & 52

Appellants respectfully submit that claims 4, 27, and 52 have a separate basis of patentability from the claims of the other subgroups, and that the rejection of the claims of this subgroup is erroneous for the reasons discussed below.

For example, claim 4 additionally claims “said allocating comprises executing an allocation technique by each file system of said plurality of file systems, wherein at least one file system of said plurality of file systems is running a different allocation technique than at least one other file system of said plurality of file systems.” As discussed above in regard to Subgroup (i) of Group I, Grimsrud does not even teach a plurality of file systems. Assuming arguendo that

Grimsrud teaches a file system, its teaching is limited to one file system which employs an allocation technique that determines how to group files for storage to adjacent disk blocks on one device. The cited portion of Grimsrud (Col. 4, lines 5-21) teaches using a single allocation technique, which consists of minimizing an access time cost function, that operates by generating multiple potential alternate disk block allocations. Grimsrud does not teach multiple file systems. Further, Grimsrud does not teach the use of different allocation techniques; rather, it teaches one technique that generates multiple candidate alternate disk block allocations. Thus, it follows that Grimsrud does not teach multiple file systems, wherein at least one file system uses an allocation technique that is different from the allocation technique used by the others.

Smith does not cure this deficiency of Grimsrud. Smith teaches a method of deciding which files to store in a cache and how to allocate storage space among partitions of the cache which are assigned to classes of data having differing priorities, but it does not teach or suggest a plurality of file systems. Therefore, it also does not teach or suggest "at least one file system of said plurality of file systems is running a different allocation technique than at least one other file system." Since neither Grimsrud nor Smith teaches or suggests this aspect of the claimed invention, the combination of Grimsrud and Smith also fails to teach or suggest the claimed invention.

The arguments presented above for claim 4 apply to the analogous system and program storage device claims 27 and 52, respectively. For the reasons stated above, appellants respectfully submit that the claims of Subgroup (v) of Group I would not have been obvious to one with ordinary skill in the art based upon the applied art, and, therefore appellants respectfully request reversal of the rejection of the claims of Subgroup (v) of Group I.

Group I, Subgroup (vi): Claims 17, 40 & 65

Appellants respectfully submit that claims 17, 40, and 65 have a separate basis of patentability from the claims of the other subgroups, and that the rejection of the claims of this subgroup is erroneous for the reasons discussed below.

For example, claim 17 recites “informing said plurality of file systems of changes in said at least one weight.” Smith (Col. 3, line 65 to Col. 4, line 10) is cited in the final Office Action in rejecting claim 17. Appellants respectfully submit that a close reading of the cited portion of Smith does not teach or suggest this claimed aspect of the present invention, but, rather, teaches reallocating cache space among cache partitions by changing partition sizes in directions that tend to equalize the most recently measured weighed hit rate slope values of the partitions. There is no teaching or suggestion in Smith of a plurality of file systems. Further, there is no teaching or suggestion in Smith of coordination among multiple file systems. In particular, Smith does not teach or suggest informing a plurality of file systems of changes in weights for storage devices.

Grimsrud is not cited in the final Office Action as prior art in rejecting claim 17. Nevertheless, appellants respectfully submit that Grimsrud also does not teach or suggest the claimed element of “informing said plurality of file systems of changes in said at least one weight.” Grimsrud teaches a computer system in which a processor executes program instructions to effectuate a method of disk block reallocation. (Col. 11, lines 1-4 and 15-20; FIG. 15, 202 and 222.) Appellants respectfully submit that Grimsrud does not teach or suggest a plurality of file systems. Also, appellants respectfully submit that Grimsrud contains no teaching or suggestion of informing multiple file systems of changes in weights for storage devices. Since there is no discussion of a plurality of file systems in Grimsrud, there is no need for coordination efforts, such as informing of other file systems of changes.

Therefore, neither reference teaches or suggests “informing said plurality of file systems of changes in said at least one weight”, which is claimed in claim 17, so the combination of these references also does not teach or suggest this feature. The arguments presented above for claim 17 apply to the analogous system and program storage device claims 40 and 65, respectively. Therefore, appellants respectfully submit that the claims of Subgroup (vi) of Group I would not have been obvious to one with ordinary skill in the art because the applied art does not teach or suggest all aspects of the claimed invention either alone or in combination. Accordingly, appellants respectfully request reversal of the rejection of the claims of Subgroup (vi) of Group I.

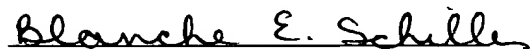
Applicants: Sawdon et al.
Serial No.: 09/618,508
Filing Date: 07/18/2000

Conclusion

Appellants respectfully submit that their claimed invention would not have been obvious to one of ordinary skill in the art based upon Grimsrud and Smith, either alone or in combination.

By way of example, appellants respectfully submit that the combination of Grimsrud and Smith is not a proper basis for an obviousness rejection for the independent claims of Group I, Subgroup (i), because neither reference teaches or suggests a plurality of file systems or allocating space on at least one storage device by a plurality of file systems of a computing environment. Since neither reference teaches these features, the combination also fails to teach or suggest these features. As another example, Grimsrud and Smith, either alone or in combination, do not teach or suggest allocating space on at least one storage device of said one or more storage devices in proportion to at least one weight obtained for the at least one storage device.

For these reasons, as well as others, appellants respectfully submit that the §103 rejection is erroneous.


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Appendix A

1. A method of managing the allocation of space on storage devices of a computing environment, said method comprising:

obtaining one or more weights for one or more storage devices of said computing environment; and

allocating space on at least one storage device of said one or more storage devices in proportion to at least one weight obtained for the at least one storage device, wherein said allocating is performed by a plurality of file systems of said computing environment.

2. The method of claim 1, wherein each of said plurality of file systems is located on a separate node of said computing environment.

3. The method of claim 1, wherein said plurality of file systems are located on one or more nodes of said computing environment.

4. The method of claim 1, wherein said allocating comprises executing an allocation technique by each file system of said plurality of file systems, wherein at least one file system of said plurality of file systems is running a different allocation technique than at least one other file system of said plurality of file systems.

5. The method of claim 1, wherein each storage device of said at least one storage device is partitioned into a plurality of partitions, and wherein one or more partitions of each storage device are owned by one or more file systems of said plurality of file systems.

6. The method of claim 1, wherein said allocating comprises allocating space on a plurality of storage devices by a plurality of file systems, wherein each file system of said plurality of file systems allocates space on one or more storage devices of said plurality of storage devices.

7. The method of claim 1, wherein said obtaining comprises using at least an allocation manager to obtain said one or more weights.

8. The method of claim 7, wherein said using comprises using said allocation manager and at least one node of said computing environment to obtain said one or more weights.

9. The method of claim 1, wherein said one or more weights represent at least one parameter of said computing environment.

10. The method of claim 1, wherein said allocating is independent of the obtaining of said one or more weights, wherein the allocating need not have knowledge of at least one of what the weights represent and how the weights were obtained.

11. The method of claim 1, wherein at least one storage device of said one or more storage devices has one or more different characteristics than at least one other storage device of said one or more storage devices.

12. The method of claim 1, further comprising propagating the at least one weight to at least one file system of said plurality of file systems.

13. The method of claim 1, further comprising:

tracking changes associated with at least one weight of said one or more weights;

adjusting said at least one weight based on the tracked changes; and

propagating the at least one adjusted weight to a file system of said computing environment, wherein said at least one adjusted weight is usable in allocating space on at least one storage device.

14. The method of claim 13, wherein said tracking is performed by the file system.

15. The method of claim 13, wherein said tracking is performed by a plurality of file systems, and wherein said propagating comprises propagating the at least one adjusted weight to the plurality of file systems that performed the tracking.

16. The method of claim 13, further comprising informing an allocation manager, at a predefined event, of the tracked changes, and wherein said allocation manager performs the adjusting and the propagating.

17. The method of claim 1, further comprising informing said plurality of file systems of changes in said at least one weight, wherein said changes are usable in further allocating space.

18. The method of claim 1, further comprising adjusting at least one weight of said one or more weights, in response to a failure of a file system of said computing environment.

19. The method of claim 18, wherein said adjusting comprises at least one of:

using information provided by at least one other file system of said computing environment to adjust said at least one weight; and

using information obtained from reading at least one storage device associated with said at least one weight to adjust said at least one weight.

20. The method of claim 1, further comprising maintaining at least one weight of said one or more weights, in response to a failure of a file system of said computing environment.

21. The method of claim 1, wherein one file system of said plurality of file systems allocates space on said at least one storage device for a given file, and wherein said allocating for that given file is based on an allocation policy that uses said at least one weight.

22. The method of claim 21, wherein said one file system allocates space on one or more storage devices for another file, and wherein the allocating for that another file is based on another allocation policy that uses one or more weights associated with the one or more storage devices.

23. A method of managing the allocation of space on storage devices of a computing environment, said method comprising:

obtaining a weight for each storage device of at least a subset of storage devices of a plurality of storage devices of said computing environment; and

allocating space on each storage device of said at least a subset of storage devices in proportion to the weight assigned to the storage device, wherein said allocating is performed by a plurality of file systems, such that each file system of said plurality of file systems allocates space on one or more storage devices of said at least said subset of storage devices.

24. A system of managing the allocation of space on storage devices of a computing environment, said system comprising:

means for obtaining one or more weights for one or more storage devices of said computing environment; and

means for allocating space, by a plurality of file systems of said computing environment, on at least one storage device of said one or more storage devices in proportion to at least one weight obtained for the at least one storage device.

25. The system of claim 24, wherein each of said plurality of file systems is located on a separate node of said computing environment.

26. The system of claim 24, wherein said plurality of file systems are located on one or more nodes of said computing environment.

27. The system of claim 24, wherein said means for allocating comprises means for executing an allocation technique by each file system of said plurality of file systems, wherein at least one file system of said plurality of file systems is running a different allocation technique than at least one other file system of said plurality of file systems.

28. The system of claim 24, wherein each storage device of said at least one storage device is partitioned into a plurality of partitions, and wherein one or more partitions of each storage device are owned by one or more file systems of said plurality of file systems.

29. The system of claim 24, wherein said means for allocating comprises means for allocating space on a plurality of storage devices by a plurality of file systems, wherein each file system of said plurality of file systems allocates space on one or more storage devices of said plurality of storage devices.

30. The system of claim 24, wherein said means for obtaining comprises means for using at least an allocation manager to obtain said one or more weights.

31. The system of claim 30, wherein said means for using comprises means for using said allocation manager and at least one node of said computing environment to obtain said one or more weights.

32. The system of claim 24, wherein said one or more weights represent at least one parameter of said computing environment.

33. The system of claim 24, wherein said means for allocating is independent of the means of obtaining of said one or more weights, wherein the means for allocating need not have knowledge of at least one of what the weights represent and how the weights were obtained.

34. The system of claim 24, wherein at least one storage device of said one or more storage devices has one or more different characteristics than at least one other storage device of said one or more storage devices.

35. The system of claim 24, further comprising means for propagating the at least one weight to at least one file system of said plurality of file systems.

36. The system of claim 24, further comprising:

means for tracking changes associated with at least one weight of said one or more weights;

means for adjusting said at least one weight based on the tracked changes; and

means for propagating the at least one adjusted weight to a file system of said computing environment, wherein said at least one adjusted weight is usable in allocating space on at least one storage device.

37. The system of claim 36, wherein said means for tracking comprises means for tracking by the file system.

38. The system of claim 36, wherein said means for tracking comprises means for tracking by a plurality of file systems, and wherein said means for propagating comprises means for propagating the at least one adjusted weight to the plurality of file systems used in the tracking.

39. The system of claim 36, further comprising means for informing an allocation manager, at a predefined event, of the tracked changes, and wherein said allocation manager performs the adjusting and the propagating.

40. The system of claim 24, further comprising means for informing said plurality of file systems of changes in said at least one weight, wherein said changes are usable in further allocating space.

41. The system of claim 24, further comprising means for adjusting at least one weight of said one or more weights, in response to a failure of a file system of said computing environment.

42. The system of claim 41, wherein said means for adjusting comprises at least one of:

means for using information provided by at least one other file system of said computing environment to adjust said at least one weight; and

means for using information obtained from reading at least one storage device associated with said at least one weight to adjust said at least one weight.

43. The system of claim 24, further comprising means for maintaining at least one weight of said one or more weights, in response to a failure of a file system of said computing environment.

44. The system of claim 24, wherein one file system of said plurality of file systems allocates space on said at least one storage device for a given file, and wherein the allocating for that given file is based on an allocation policy that uses said at least one weight.

45. The system of claim 44, wherein said one file system allocates space on one or more storage devices for another file, and wherein the allocating for that another file is based on another allocation policy that uses one or more weights associated with the one or more storage devices.

46. A system of managing the allocation of space on storage devices of a computing environment, said system comprising:

means for obtaining a weight for each storage device of at least a subset of storage devices of a plurality of storage devices of said computing environment; and

a plurality of file systems adapted to allocate space on each storage device of said at least a subset of storage devices in proportion to the weight assigned to the storage device, wherein each file system of said plurality of file systems allocates space on one or more storage devices of said at least said subset of storage devices.

47. A system of managing the allocation of space on storage devices of a computing environment, said system comprising:

at least one node adapted to obtain one or more weights for one or more storage devices of said computing environment; and

a plurality of nodes adapted to allocate space on at least one storage device of said one or more storage devices in proportion to at least one weight obtained for the at least one storage device.

48. The system of claim 47, wherein said plurality of nodes comprise said at least one node.

49. At least one program storage device readable by a machine, tangibly embodying at least one program of instructions executable by the machine to perform a

method of managing the allocation of space on storage devices of a computing environment, said method comprising:

obtaining one or more weights for one or more storage devices of said computing environment; and

allocating space on at least one storage device of said one or more storage devices in proportion to at least one weight obtained for the at least one storage device, wherein said allocating is performed by a plurality of file systems of said computing environment.

50. The at least one program storage device of claim 49, wherein each of said plurality of file systems is located on a separate node of said computing environment.

51. The at least one program storage device of claim 49, wherein said plurality of file systems are located on one or more nodes of said computing environment.

52. The at least one program storage device of claim 49, wherein said allocating comprises executing an allocation technique by each file system of said plurality of file systems, wherein at least one file system of said plurality of file systems is running a different allocation technique than at least one other file system of said plurality of file systems.

53. The at least one program storage device of claim 49, wherein each storage device of said at least one storage device is partitioned into a plurality of partitions, and wherein one or

more partitions of each storage device are owned by one or more file systems of said plurality of file systems.

54. The at least one program storage device of claim 49, wherein said allocating comprises allocating space on a plurality of storage devices by a plurality of file systems, wherein each file system of said plurality of file systems allocates space on one or more storage devices of said plurality of storage devices.

55. The at least one program storage device of claim 49, wherein said obtaining comprises using at least an allocation manager to obtain said one or more weights.

56. The at least one program storage device of claim 55, wherein said using comprises using said allocation manager and at least one node of said computing environment to obtain said one or more weights.

57. The at least one program storage device of claim 49, wherein said one or more weights represent at least one parameter of said computing environment.

58. The at least one program storage device of claim 49, wherein said allocating is independent of the obtaining of said one or more weights, wherein the allocating need not have knowledge of at least one of what the weights represent and how the weights were obtained.

59. The at least one program storage device of claim 49, wherein at least one storage device of said one or more storage devices has one or more different characteristics than at least one other storage device of said one or more storage devices.

60. The at least one program storage device of claim 49, wherein said method further comprises propagating the at least one weight to at least one file system of said plurality of file systems.

61. The at least one program storage device of claim 49, wherein said method further comprises:

tracking changes associated with at least one weight of said one or more weights;

adjusting said at least one weight based on the tracked changes; and

propagating the at least one adjusted weight to a file system of said computing environment, wherein said at least one adjusted weight is usable in allocating space on at least one storage device.

62. The at least one program storage device of claim 61, wherein said tracking is performed by the file system.

63. The at least one program storage device of claim 61, wherein said tracking is performed by a plurality of file systems, and wherein said propagating comprises propagating the at least one adjusted weight to the plurality of file systems that performed the tracking.

64. The at least one program storage device of claim 61, wherein said method further comprises informing an allocation manager, at a predefined event, of the tracked changes, and wherein said allocation manager performs the adjusting and the propagating.

65. The at least one program storage device of claim 49, wherein said method further comprises informing said plurality of file systems of changes in said at least one weight, wherein said changes are usable in further allocating space.

66. The at least one program storage device of claim 49, wherein said method further comprises adjusting at least one weight of said one or more weights, in response to a failure of a file system of said computing environment.

67. The at least one program storage device of claim 66, wherein said adjusting comprises at least one of:

using information provided by at least one other file system of said computing environment to adjust said at least one weight; and

using information obtained from reading at least one storage device associated with said at least one weight to adjust said at least one weight.

68. The at least one program storage device of claim 49, wherein said method further comprises maintaining at least one weight of said one or more weights, in response to a failure of a file system of said computing environment.

69. The at least one program storage device of claim 49, wherein one file system of said plurality of file systems allocates space on said at least one storage device for a given file, and wherein the allocating for that given file is based on an allocation policy that uses said at least one weight.

70. The at least one program storage device of claim 69, wherein said one file system allocates space on one or more storage devices for another file, and wherein the allocating for that another file is based on another allocation policy that uses one or more weights associated with the one or more storage devices.

71. At least one program storage device readable by a machine, tangibly embodying at least one program of instructions executable by the machine to perform a

method of managing the allocation of space on storage devices of a computing environment, said method comprising:

obtaining a weight for each storage device of at least a subset of storage devices of a plurality of storage devices of said computing environment; and

allocating space on each storage device of said at least a subset of storage devices in proportion to the weight assigned to the storage device, wherein said allocating is performed by a plurality of file systems, such that each file system of said plurality of file systems allocates space on one or more storage devices of said at least said subset of storage devices.